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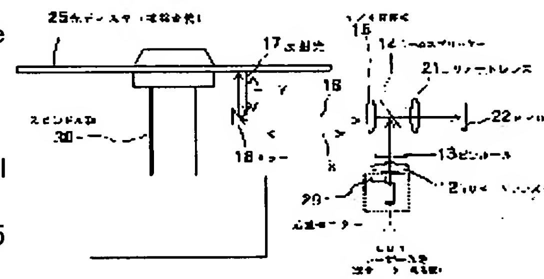
(54) OPTICAL-DISC INSPECTING DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an optical-disc inspecting device which can multilaterally inspect inspection items such as the optical tilt angle, deflection of surface and reflectance of an optical disk and so on at a time.
SOLUTION: A laser beam source 11; a beam splitter 14 which changes the direction of laser beam from the laser beam source 11; mirrors 18, 19 and 20 which change the direction of the laser beam from the beam splitter 14 to perpendicularly radiate the beam to materials 25 under inspection; mirror- switching means 23 and 24 for setting the mirrors free from a spot optical axis; and a photoreceptor 22 for detecting two-dimensional position which receives the reflected light from the materials 25 under inspection through the beam splitter 14 and detects a light-receiving position; are provided.



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CLAIMS

[Claim(s)]
[Claim 1] The laser light source and the beam splitter which the laser light from said laser light source makes turn, The mirror for changing the direction of the laser light from said beam splitter, and irradiating perpendicularly to an inspected object, The mirror means for switching for making said mirror avoid from a spot optical axis, Optical disk test equipment characterized by providing the photo detector for two-dimensional location detection which receives the reflected light reflected from said inspected object through said beam splitter, and detects the light-receiving location and the light income of the reflected light.

[Claim 2] The laser light source and the beam splitter which the laser light from said laser light source makes turn, The mirror for changing the direction of the laser light from said beam splitter, and irradiating perpendicularly to an inspected object, The mirror means for switching for making said mirror avoid from a spot optical axis, Optical disk test equipment characterized by providing the photo detector for two-dimensional location detection which receives the reflected light reflected from said inspected object through said beam splitter, and detects the light-receiving location and the light income of the reflected light, and the 2nd photo detector which acts as the monitor of the quantity of light of the laser light source.
[Claim 3] Optical disk test equipment according to claim 1 or 2 which said mirror is carried in the mirror migration means, and is characterized by being movable to radial [of an inspected object].
[Claim 4] Optical disk test equipment according to claim 1 to 3 which is what said mirror means for switching becomes from a pneumatic cylinder, an oil hydraulic cylinder, a solenoid device, a cam mechanism, or a screw device.
[Claim 5] Optical disk test equipment according to claim 1 to 3 said whose mirror means for switching is what rotates as a core the mirror revolving shaft prepared in the end section of a mirror.
[Claim 6] The laser light source and the beam splitter which the laser light from said laser light source makes turn, The mirror for changing the direction of the laser light from said beam splitter, and irradiating perpendicularly to an inspected object, The mirror means for switching for making said mirror avoid from a spot optical axis, The photo detector for two-dimensional location detection which receives the reflected light reflected from said inspected object through said beam splitter, and detects the light-receiving location and the light income of the reflected light, Optical disk test equipment characterized by providing and computing the optical tilt angle of said inspected object, and the amount of face deflections based on the detecting signal of the photo detector for said two-dimensional location detection.
[Claim 7] The laser light source and the beam splitter which the laser light from said laser light source makes turn, The mirror for changing the direction of the laser light from said beam splitter, and irradiating perpendicularly to an inspected object, The mirror means for switching for making said mirror avoid from a spot optical axis, The photo detector for two-dimensional location detection which receives the reflected light reflected from said inspected object through said beam splitter, and detects the light-receiving location and light income, The 2nd photo detector which acts as the monitor of the quantity of light of the laser light source, and the spindle motor which rotates an inspected object, Optical disk test equipment characterized by providing, computing the optical tilt angle of said inspected object, and the amount of face deflections based on the detecting signal of the photo detector for said two-dimensional location detection, and computing a reflection factor based on the detecting signal of the photo detector for said two-dimensional location detection, and the detecting signal of the 2nd photo detector.
[Claim 8] Optical disk test equipment characterized by judging whether said inspected object is in a predetermined value of standard as compared with each set point about the result of said computed optical tilt angle, the amount of face deflections, and a reflection factor in test equipment according to claim 1 to 7.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical sensor unit for detecting the optical tilt angle of media (said medium is hereafter called optical disk), such as CD (KOMPAKU disk), DVD, DVD-R, DVD-R/W, DVD-RAM, CD-R, CD-R / W, MO, the amount of face deflections, a reflection factor, etc. especially, and the optical De Dis test equipment using it about the technique of detecting the inclination (optical tilt angle) of inspected objects, such as a rotor plate object, face deflection, a reflection factor, etc. with high precision.
[0002]
[Description of the Prior Art] CD, DVD, MO, etc. become important [a playback jitter value], in case the quality of an optical disk is judged. A playback jitter is time fluctuation of the electrical signal at the time of the data playback recorded on the optical disk, and the data recorded as this becomes large cannot be reproduced correctly. As the cause, the curvature of an optical disk, face deflection, and a property influence greatly. The defect of these properties is generated in an optical disk production process, it is a self-weight, and manufacture conditions, especially a DVD replication lamination process, and the optical disk itself curves delicately, and this serves as a face deflection defect of an optical disk, and appears. When the coating condition of the front face of an optical disk and the condition of having performed spreading are not uniform, a fixed reflection factor may not be shown and this may be able to stop moreover, being able to reproduce data correctly similarly owing to. Conventionally, these defects had the measurement by the optical stylus method which used the highly precise optical pickup, or a common inspection which combined the reflectometer and the laser displacement gage, although in-line total inspection was conducted since the quality of an optical disk product was spoiled.
[0003]
[Problem(s) to be Solved by the Invention] There was a case where there was a limit of a tact time for a low speed in the case where there were also many problems, such as that structure is complicated and it is hard to become small and become unsuitableness and a large sum at in-line inspection at a low speed, and a reflectometer and a laser displacement gage are combine, or it was the configuration of the land group of the optical disk Records Department, and the measurement itself could not be performed at the case where these approaches use a highly precise optical pickup as a sensor. Furthermore, it was quite difficult for one small test equipment which needs space-saving for a highly precise optical pickup, a laser displacement gage, and each reflection factor system to include in coincidence.
[0004] Moreover, DVD [recently] of high density record serves as substrate lamination of 0.6mm thickness, 0.74micro and a laser spot are also 1micro or less, densification advances much more, and, as for the track pitch made detailed, the allowed value of not only an exterior defect but mechanical and optical terms and conditions and threshold value are very small. In DVD-R in which a store/rewriting is especially possible, DVD-R/W, DVD-RAM, CD-R, and CD-R/W, it is still more so.
[0005] Furthermore, it is not that it is easy for the optical disk with which improvement in the speed progresses to apply a focus servo tracking servo to stability at a submicron high precision high speed. Precision maintenance of a product is needed more than former. The replication process of optical disk manufacture, In each process of the record stratification and protective coat formation Face deflection, a reflection factor, etc., While a machine and an optical property, and total inspection become indispensable and inspection can carry out to a high speed at an in-line total inspection process, it excels also in maintainability and the appearance of test equipment which can perform effective productivity drives, such as being a low price, is demanded recently. In order that the technical problem of this invention may realize

these the demands of many, it is simple and is to offer the optical disk test equipment with which an optical disk is made as for inspection to a high speed.

[0006]

[Means for Solving the Problem] The beam splitter which the laser light from the laser light source and the laser light source makes turn the optical disk test equipment of this invention, The mirror for changing the direction of the laser light from a beam splitter, and irradiating perpendicularly to an inspected object, It is characterized by providing the mirror means for switching for making a mirror avoid from a spot optical axis, and the photo detector for two-dimensional location detection which receives the reflected light which reflected from the inspected object through a beam splitter, and detects the light-receiving location and the light income of the reflected light. Moreover, the beam splitter which the laser light from the laser light source and the laser light source makes turn the optical disk test equipment of this invention, The mirror for changing the direction of the laser light from a beam splitter, and irradiating perpendicularly to an inspected object, The mirror means for switching for making a mirror avoid from a spot optical axis, and the photo detector for two-dimensional location detection which receives the reflected light which reflected from the inspected object through a beam splitter, and detects the light-receiving location and the light income of the reflected light, It is characterized by providing the 2nd photo detector which acts as the monitor of the quantity of light of the laser light source. As for these optical disk test equipment, it is desirable that it is what the mirror is carried in the mirror migration means and rotates as a core the mirror revolving shaft which it was desirable that it is movable to radial [of an inspected object], and was what a mirror means for switching becomes from a pneumatic cylinder, an oil hydraulic cylinder, a solenoid device, a cam mechanism, or a screw device, or was prepared in the end section of a mirror. Furthermore, the beam splitter which the laser light from the laser light source and the laser light source makes turn the optical disk test equipment of this invention, The mirror for changing the direction of the laser light from a beam splitter, and irradiating perpendicularly to an inspected object, The mirror means for switching for making a mirror avoid from a spot optical axis, and the photo detector for two-dimensional location detection which receives the reflected light which reflected from the inspected object through a beam splitter, and detects the light-receiving location and the light income of the reflected light, It provides and is characterized by computing the optical tilt angle of an inspected object, and the amount of face deflections based on the detecting signal of the photo detector for two-dimensional location detection. Furthermore, the beam splitter which the laser light from the laser light source and the laser light source makes turn the optical disk test equipment of this invention, The mirror for changing the direction of the laser light from a beam splitter, and irradiating perpendicularly to an inspected object, The mirror means for switching for making a mirror avoid from a spot optical axis, and the photo detector for two-dimensional location detection which receives the reflected light which reflected from the inspected object through a beam splitter, and detects the light-receiving location and light income, The 2nd photo detector which acts as the monitor of the quantity of light of the laser light source, and the spindle motor which rotates an inspected object, It provides, the optical tilt angle of an inspected object and the amount of face deflections are calculated based on the detecting signal of the photo detector for two-dimensional location detection, and it is characterized by computing a reflection factor based on the detecting signal of the photo detector for two-dimensional location detection, and the detecting signal of the 2nd photo detector. Moreover, the optical disk test equipment of this invention is characterized by judging whether as compared with each set point, said inspected object is in a predetermined value of standard about the result of said optical tilt angle, amount of face deflections, and reflection factor **.

[0007]

[Embodiment of the Invention] Hereafter, the gestalt of operation of the optical disk test equipment of this invention is explained to a detail, referring to a drawing. The basic configuration of optical disk test equipment as 1 operation gestalt of this invention is shown in drawing 1 . Collimation (parallel-pencil-of-rays-izing) is carried out, and it becomes parallel light, and the laser light which came out from the laser light source (LD1) 11 in the direction of facing up in drawing 1 turns into about [phi1mm] parallel spot laser light, and it is a collimate lens 12 and it turns into [it is a pinhole 13 and / it is reflected by the beam splitter 14, and a travelling direction is changed into it horizontally (the direction of X), it passes the quarter-wave length plate 15, and] phi1mm spot-like parallel laser light of a circularly-polarized wave. And the lower part of the optical disk 25 supported pivotable with the spindle shaft 30 irradiates on mirror 18 front face by which fixed installation was carried out. Here, the mirror 18 is installed on the spot optical axis 16 of the direction of X, a travelling direction is changed into the spot light which carried out incidence to mirror 18 front face perpendicularly (the direction of Y), and it is perpendicularly irradiated to optical disk 25 front

face.
[0008] According to the law of reflection, the spot light which carried out incidence to the right angle to optical disk 25 front face turns into the reflective spot light 17, follows the route which came origin, can change a travelling direction horizontally (the direction of X) on mirror 18 front face, and passes the quarter-wave length plate 15 and a beam splitter 14, and it is a collimate lens 21 and they carry out image formation to photo detector (PSD) 22 front face currently installed in the posterior part. Here, as a photo detector (PSD), the two-dimensional photo detector (two-dimensional position sensitive detector ;P. osition sensitive detector) arranged in the focal distance f is mentioned, for example. This two-dimensional photo detector is a position transducer for two-dimensional location detection, and the optical structure of this configuration is used for inspecting the optical tilt angle of an optical disk so that the postscript of a kind of autocollimator may be constituted and carried out. In addition, a two-dimensional photo detector (PSD) is constituted from an N layer and one middle layer by the front face of plate-like silicon at P layers and the rear face, the split output of the light by which incidence was carried out to the two-dimensional photo detector (PSD) is carried out from the electrode which photo electric conversion was carried out and was attached to P layers or N layer as a photocurrent, and it can ask for the incidence location of light by the operation regardless of incidence energy.
[0009] Drawing 2 is the schematic diagram showing other operation gestalten of this invention, (a) is the top view and (b) is the front view. In the gestalt of this operation, as for the mirror, plurality is installed on the spot optical axis 16 of the direction of X. If the case where three mirrors are installed is described as shown in drawing 2 R> 2 for example, the mirror 19 and mirror 20 which were installed in the location near the laser light source (LD1) 11 have the mirror change means 23 and 24 so that the installation location on the spot optical axis 16 of the direction of X can be avoided. A laser spot-like light can irradiate each of mirrors 18 and 19 and 20 front faces by the drive of these mirror means for switching 23 and 24. That is, when the mirror 20 installed in the location near the laser light source (LD1) 11 is located on the spot optical axis 16 of the direction of X, it is reflected by the mirror 20 and it does close and reflection of a laser spot-like light in the periphery section 28 of an optical disk 25.
[0010] Moreover, by the mirror means for switching 23 and 24, when the mirror 19 installed in the near location from the laser light source (LD1) 11 and the mirror 20 have avoided the location on the spot optical axis 16 of the direction of X, it is reflected by the mirror 18 installed in the most distant location from the laser light source (LD1) 11, and they do close and reflection of a laser spot-like light in the inner circumference section 26 of an optical disk 25. Furthermore, when the mirror 19 which the mirror 20 has avoided the location on the X-axis, and has it in a middle location is in the location on the X-axis, it is reflected by the mirror 19 and close and reflection of a laser spot-like light are done in the radial pars intermedia 27 of an optical disk 25. Thus, laser light can be irradiated in an instant by switching the mirror in which laser light is reflected at two or more radial places of an optical disk 25 using one set of the laser light source.
[0011] Next, the mirror means for switching 23 and 24 for switching the mirror in which laser light is reflected are explained. Drawing 3 and drawing 4 are the schematic diagrams showing the mirror means for switching of this invention. As shown in drawing 3 , the mirror means for switching 23 and 24 for avoiding a mirror location are formed in the mirror 19 and the mirror 20 from the spot optical axis 16 of the direction of X in mirrors 19 and 20, and the mirror 19 and the mirror 20 are made movable free [frequent appearance] in the arrow head P and the direction of Q, respectively. Although the location in which mirrors 19 and 20 are installed shows the gestalt avoided to an inspected object and a parallel direction (horizontal) by drawing 3 , the gestalt avoided to down [of an inspected object] is sufficient as it. As such mirror means for switching 23 and 24, a pneumatic cylinder, an oil hydraulic cylinder, a solenoid device, a cam mechanism, a screw device, etc. can be used. It is a small motor when forming the cams 31 and 32 of the rotation mold which attached the small motors M1 and M2 in the mirror means for switching 23 and 24 when using a cam mechanism, and avoiding a mirror location. If rotation is given to M1 and M2, mirrors 19 and 20 will become in an arrow head P and the direction of Q movable free [frequent appearance] similarly. In addition, to the spot optical axis 16, the evasion direction of mirrors 19 and 20 is established so that it may move to a lower part or a horizontal direction, but if there is a tooth space in test equipment, slant etc. will be sufficient and the direction will not be asked. Moreover, as shown in drawing 4 , a revolving shaft can be prepared in the mirror lower part, and a means to upset revolving shafts 33 and 34 in an arrow head R and the direction of S for mirrors 19 and 20 as the center of rotation can also be used.
[0012] In addition, the above-mentioned mirrors 18, 19, and 20 are independent or plurality, and may be installed on the mirror migration means 35. By moving this mirror migration means 35 in the direction of

arrow-head T, the relative location of an optical disk 25, the laser light source (LD1) 11, and mirrors 18, 19, and 20 can be adjusted. In order to move the mirror migration means 35 in the direction of arrow-head T, a pneumatic cylinder, an oil hydraulic cylinder, a cam mechanism, a screw device, etc. can be used. Spacing which each of the above-mentioned mirrors 18, 19, and 20 accomplishes can also be justified so that spot light can be irradiated in the location according to the inspected part of an optical disk 25. Moreover, the installation number of a mirror is suitably decided by the number of parts to inspect, such as not only one piece but two pieces or four etc. pieces or more.

[0013] By arranging two or more mirrors in the shape of a straight line to the fixed inspected object, and making an inspected object turn, although the mode in the case of switching a mirror one by one and inspecting it is explained next, the above irradiates the spot light reflected by the mirror at an inspected object, and can inspect the hand of cut of an inspected object. switching two or more mirrors one by one by the mirror means for switching, and using also in this case, -- an inspected object -- the whole surface can be inspected mostly.

[0014] (Optical tilt angle) Next, the gestalt of the operation which inspects an optical tilt angle (= inclination) is explained using this equipment. In drawing 1 , if spot light carries out incidence to a right angle to an optical disk 25, the coordinate location whose reflected light 17 also follows the route which came origin as it is, and it carries out image formation on photo detector (PSD) 22 front face will be a zero. However, when an optical disk 25 is not in a completely flat [owing to] curvature condition, incidence of the spot light is not carried out to a right angle to an optical disk 25, but a different route from the route by which the reflected light 17 from an optical disk 25 also came origin is followed, and the coordinate location which carries out image formation on photo detector (PSD) 22 front face turns into location [zero] shifted. The optical tilt angle of an optical disk 25 can be inspected by measuring this distance shifted.

[0015] Furthermore, the location where the mirror in which spot light is reflected is switched, and optical disks differ is irradiated, and continuous change of the optical tilt angle of an optical disk 25 can be inspected by measuring each image formation location of the reflected light on photo detector (PSD) 22 front face. And if spindle shaft 30 core is made to turn an optical disk 25, continuous change of the optical tilt angle of the hand of cut of an optical disk 25 can also be inspected. However, since the coordinate location which carries out image formation on a photo detector (PSD) 22 contains the amount of inclinations of spindle shaft 30 the very thing, it is measuring beforehand the amount of displacement of these spindle shaft itself by the another technique, deducting from actual measurement data, and performing signal separation (amendment), and becomes possible [inspecting the optical tilt angle of an optical disk correctly].

[0016] (Calculation of optical tilt angle alpha) Next, how to compute optical tilt angle alpha concretely using the output signal from a photo detector (PSD) 22 is explained using drawing 5 . By receiving reflective spot light by the photo detector (PSD) 22, in detection of optical tilt angle alpha, the distance (distance between zero-reflected light image formation coordinates) of an angle of incidence/angle of reflection can be calculated, and inclination = optical tilt angle alpha of an optical disk can be computed to it. That is, in drawing 5 R> 5, optical tilt angle alpha is [the distance dx (the distance of Y shaft orientations is dy) of X shaft orientations on a photo detector (PSD) light-receiving side] computable using alpha=dx / 2f formula.

[0017] (Calculation of the amount H of face deflections) Next, the calculation approach of the amount H of face deflections of an optical disk is explained using Table 1 and drawing 6 . height [in / Table 1 inspects six optical tilt angle alpha, sets the detection include angle in each check point to alpha1-alpha6, and / each check point in that case], and accumulation height -- the gestalt of 1 operation of the approach of computing a variation rate (the amount of face deflections) is shown. Drawing 6 sets an axis of ordinate as the amount H of face deflections computed based on Table 1, sets an axis of abscissa as a check point location, and graph-izes it. If this approach is explained in detail, an optical disk will be first rotated for the spot light reflected by the mirror 18 1 round, and an optical tilt angle (alpha1, alpha2, alpha3 ...) will be inspected to a circumferencial direction at every fixed interval (deltac). every inspection point spacing (=deltac) -- the variation rate of optical tilt angle alpha in each inspection point -- amount deltah (=deltactanalpha) -- calculating -- these variation rates -- carrying out accumulation of the amount deltah -- the amount of face deflections in each inspection point -- H1, H2, and H3 -- as ... computing -- the face deflection of drawing 6 R> 6 -- a variation rate -- the amount curve L1 can be drawn. in addition, the face deflection shown in drawing 6 -- a variation rate -- the amount curve L1 is based on the measurement start point for the amount H of face deflections.

[0018]

[Table 1]

各測定点における検出角度	各測定点における高さ	累積高さ変位（面振れ量）
α 1	Δ h1(=Δ c tan α 1)	H1(=Δ h1)
α 2	Δ h2(=Δ c tan α 2)	H2(= H1+Δ h2)
α 3	Δ h3(=Δ c tan α 3)	H3(= H2+Δ h3)
α 4	Δ h4(=Δ c tan α 4)	H4(= H3+Δ h4)
α 5	Δ h5(=Δ c tan α 5)	H5(= H4+Δ h5)
α 6	Δ h6(=Δ c tan α 6)	H6(= H5+Δ h6)

[0019] The amount H of face deflections computes the amount of face deflections of the circumferencial direction explained above, the radial amount of face deflections, the amount of face deflections of a circumferencial direction, and both directions. namely, the face deflection which computes the amount of hoop direction face deflections of the truck of an optical disk, and the radial amount of face deflections of an optical disk based on the formula and deltah1=deltac-tanalpha which were mentioned above, respectively, and shows them to drawing 6 -- a variation rate -- the amount curve L1 is drawn. As for this amount of face deflections, it is desirable from the convenience on count for it not to be necessary to measure an absolute value and to make a relative origin/datum into "the outermost periphery of optical disk clamp area." Moreover, when asking for the acceleration of field blurring, an optical tilt angle (include-angle data) can be computed by differentiating the first degree.
[0020] (Measurement of a reflection factor) Next, the reflection factor of an optical disk can be inspected by measuring continuously a detailed change of the quantity of light of the reflected light. The laser light which came out of the laser light source (LD1) 11 in drawing 1 is with a collimate lens 12. It becomes parallel light and becomes spot light at a pinhole 13, it is bent by the beam splitter 14 and becomes a circularly-polarized wave with the quarter-wave length plate 15, and it is a mirror 18, and is bent, and an optical disk (inspected object) 25 irradiates. It is reflected, and the laser light of the shape of an irradiated spot is bent by the mirror 18, passes along quarter-wave length plate 15 **, and passes a beam splitter 14, it is a collimate lens 21 and image formation is carried out to a photo detector (PSD) 22.
[0021] While a photo detector (PSD) 22 measures the center-of-gravity location of the laser spot light which received light, it can measure the reinforcement of the light energy (light income). In order to measure own laser output reinforcement, to the laser light source (LD1) 11, it is desirable to have included the 2nd photo detector (a photodetector, PD1) 29 in the interior, and it can carry out direct monitor measurement of the laser output of the laser light source (LD1) 11 at it. The ratio of the value which deducted light income is computable as a reflection factor from the laser output of this laser light source (LD1) 11. In the gestalt of operation of this invention, the reflection factor r of an optical disk is computable using the following (1) type.
r=n1, p1/p0 ... (1)
Here, p1 is a constant of a proper in which laser output monitor reinforcement has the light-receiving quantity of light reinforcement of the reflected light in a photo detector (PSD), and p0, and the quality of the material of an optical disk and optical system have n1.
[0022] (Optical disk test equipment) Next, the case where the automatic check of an optical disk is conducted is explained using the optical disk test equipment of this invention. Drawing 7 shows the gestalt of the 1 operation which shows signal processing in the equipment attached to the optical disk test equipment of this invention, and it.
[0023] (A/D converter) As shown in drawing 7 , the X coordinate (location) data of a light-receiving laser spot from the photo detector (PSD) 22 which are an object for two-dimensional location detection and a light income sensing element, Y coordinate (location) data, and light-receiving quantity of light data are inputted into A/D converter 51. And buffered A/D converter 51 equalizes the data of the light-receiving quantity of light from the sampled photo detector (PSD), and feedback control of the quantity of light output of the semiconductor laser light source (LD1) is carried out via the laser control circuit 53 so that it may become the fixed light-receiving quantity of light. In addition, in order to maintain the high-speed engine performance, as for A/D converter 51, it is desirable to have the capacity that it can operate to an a maximum of 10 Mhz sample.
[0024] (Laser output control) It is desirable to adopt the object with which the 2nd photo detector PD 1 which is the semiconductor laser quantity of light monitor for an output monitor in which the output of about 5mW is possible was included in the laser light source (LD1). Moreover, in order to improve the

linearity of a photo detector (PSD) 22, it is also desirable to form the laser control circuit 53 for the purpose of performing feedback control so that light income may become fixed on a photo detector (PSD) 22.
[0025] In addition, as for the quantity of light data of the 2nd photo detector PD 1 (semiconductor laser quantity of light monitor) included in the laser diode of the laser light source (LD1) itself with the gestalt of this operation, it is desirable to make it the configuration which the laser optical output of the laser light source (LD1) is directly inspected at the time of reflection factor inspection of an optical disk, and the laser light source (LD1) is degradation etc., and can also carry out the monitor at the time of causing the abnormalities in an output to coincidence.
[0026] (Process controller) In the gestalt of this operation, the process controller 54 has the role which controls adsorption (it fixes to a spindle) of an optical disk etc. to a spindle 30. Furthermore, control of this whole test equipment and the working status are supervised, and it also has the role which outputs a control signal to the robot for handling which installed outside. moreover It has the role which emits the control command for a mirror change-over.
[0027] (Servo-motor controller) In the gestalt of this operation, the servo-motor controller 59 carries out the roll control of the spindle motor 55 which rotates the spindle shaft 30 (motor driver). Moreover, the pulse from an encoder attached in the spindle motor 55 is read, and the location of an angle of rotation is supervised to coincidence (encoder control circuit 56).
[0028] (Control of a mirror means for switching) In the gestalt of this operation, the mirror means-for-switching control circuit 57 was installed in order to operate the cylinder for making it avoid from an optical axis in order to change the measurement location of an optical disk, and it has received the command from the process controller.
[0029] (System control CPU) In the gestalt of this operation, system control CPU60 controls the whole optical disk test equipment, and it is the sake of maintenance of a program, and preservation of data. It has the network controller for connection with CD-ROM for a hard disk drive HDD and a program setup, FDD, and the host CPU etc. It is desirable to also attach printer equipment as a console for operation for a report of a CRT display device and a defect.
[0030] Next, the optical disk test equipment of this invention is used for drawing 8 - drawing 13 , and the flow chart in the case of inspecting an optical disk continuously is shown and explained to them. With the gestalt of this operation, the number of samplings explains the case where it divides and measures to three points (three trucks) and 2048 hoop directions a radius side.
[0031] The Maine flow in the case of performing continuous inspection for an optical disk to drawing 8 is shown. In drawing 8 , if a measurement start (**) is carried out, the optical disk test equipment of this invention is automated by the following flow.
- Sample data (#1).
- Compute an optical tilt angle (#2).
- Compute the amount of face deflections / face deflection acceleration (#3).
- Carry out reflection factor calculation (#4).
- Carry out the comprehensive judgment of a result (#5).
[0032] Next, the example at the time of using the mirror means for switching 23 and 24 is taken using drawing 9 , and a step is further stated for the stroke of a sampling of the data of #1 shown by drawing 8 to a detail later on. First, the sampling of - data is started after measurement start ** of drawing 8 (S1).
- The truck counter which is made to avoid starting and mirrors 19 and 20 (to refer to drawing 2) for the spindle shaft 30 from the spot optical axis 13 of the direction of X, irradiates the spot light from the laser light source (LD1) 11 at a mirror 18, and shows a radial measurement location = set 0 (S2).
- And stand by until it reaches the constant speed to which the rotational speed of the spindle shaft 30 can measure (S3).
- It is referred to as sample counter =0 before beginning a data sample, if the rate which can measure the rotational speed of the spindle shaft 30 is reached (S4).
- In order to grasp the sample location sampled to the rotation hoop direction of each truck location, stand by until it receives the pulse from the encoder which shows a rotation sample location (S5).
[0033] - If an encoder pulse is received, the following data will be read immediately.
a. X location data of the 2nd photo detector (PSD) (for optical tilt calculation)
b. Y location data of the 2nd photo detector (PSD) (for optical tilt calculation)
c. Quantity of light data of the 2nd photo detector (PSD) (for reflection factor calculation)
d. Luminescence quantity of light data of the laser light source (LD1) (for reflection factor calculation)
The sample counter +1 is carried out after performing a-d for the next sampling (S6).

- As a result of performing the sample counter +1, repeat until it investigates whether it was set to sample counter =2048, and it ends a 2048-point sampling, when having not reached (S7).
- When one truck, and 1-round the sampling of 2048 points are completed, carry out the measurement truck counter +1 (S8).
- Measurement truck counter = when there is nothing 1, in order to investigate whether it is measurement truck counter =2, move to the following sequence (S11) (S9).
- Measurement truck counter = in order to measure the truck location of a degree, to a mirror 19, in the case of 1, carry out measuring-point migration control immediately (S10), it waits for the time amount which impaction efficiency takes, and moves to the sequence (S4) of the next sampling. As a result, the spot light from the laser light source (LD1) 11 is irradiated by the mirror 19 (S10).
- Measurement truck counter = when there is no 2, judge it as measurement truck counter =3, and move to a data sampling termination sequence (S13). (S11)
- Measurement truck counter = in order to measure the truck location of a degree, to a mirror 20, in the case of 2, carry out measuring-point migration control immediately, it waits for the time amount which impaction efficiency takes, and moves to the sequence (S4) of the next sampling. As a result, the spot light from the laser light source (LD1) 11 is irradiated by the mirror 20 (S12).
- In order to end all the data sampling sequence, take out a halt command to the spindle shaft 30, make it avoid mirrors 19 and 20 from the spot optical axis 16 of the direction of X, and prepare for it at the next measurement (S13).
- Here, end a data sampling stroke (S14).

[0034] Next, a step is further stated for the optical tilt calculation stroke of #2 shown by drawing 8 to a detail later on using drawing 10 . First, calculation of - optical tilt is started after ** of drawing 9 (S15).
- The truck counter which shows a measurement location before starting calculation = set 0 (S16).
- Convert X location data of the 2nd photo detector (PSD) of the data of the 2nd photo detector (PSD), and 2048 per round, and Y location data of the 2nd photo detector (PSD), consider as dx (dy) data, and carry out sequential calculation of the part 2048 points for one truck for a beta angle and an alpha angle (tilt angle) from a focal distance f (S17).
- In order to compute the truck location of a degree, carry out the truck counter +1 (S18).
- Truck counter = when having not come to check whether it was set to 3, move in order to compute the truck location of a degree (S19). (S17)
- Plot the result of having computed all the sampled data, to a CRT display in a part for three trucks, and a hoop direction if needed (S20).
- Here, end the calculation stroke of an optical tilt (S21).

[0035] Next, a step is further stated for the amount of face deflections of #3 shown by drawing 9 , and the calculation stroke of face deflection acceleration to a detail later on using drawing 11 . First, calculation of the amount of - face deflections and face deflection acceleration is started after ** of drawing 10 (S22).
- The truck counter which shows a measurement location before starting calculation = set 0 (S23).
- Convert X location data of the photo detector (PSD) of the data of the photo detector (PSD) of the preceding clause, and 2048 per round, and Y location data of a photo detector (PSD). Consider as dx (dy) data, and from a focal distance f, although sequential calculation (S17) of the part 2048 points for one truck was carried out, a beta angle and an alpha angle (optical tilt angle) From this tilt data, a variation rate is calculated for all the data of 2048 trucks of an optical tilt alpha angle in the height of hoop direction each point of measurement by deltah1=deltactanalpha (S24).
- Differentiate the first (include-angle data) degree of all the data of 2048 trucks of an optical tilt alpha angle, and carry out hoop direction face deflection acceleration count (S25).
- Here, calculate a variation rate (the amount of hoop direction face deflections) in the accumulation height of a hoop direction (S26).
- In order to compute the truck location of a degree, carry out the truck counter +1 (S27).
- Truck counter = when having not come to check whether it was set to 3, move in order to compute the truck location of a degree (S28). (S24)
- Plot the result of having computed all the sampled data, to a CRT display in a part for three trucks, and a hoop direction if needed (S29).
- Here, end the calculation stroke of the amount of face deflections, and face deflection acceleration (S30).

[0036] Next, reflection factor calculation stroke of #4 shown by drawing 9 using drawing 12 A step is further stated to a detail later on. First, calculation of - reflection factor is started after ** of drawing 11 (S31).

- The truck counter which shows a measurement location before starting calculation = set 0 (S32).
- It is reflection factor r=ni-p1 / p0 from p0 and p1 of the quantity of light data of the 2nd photo detector (PSD) of the data of the preceding clause, and 2048 per round, and the luminescence quantity of light data of the semiconductor laser light source (LD1) 11 to a homotopic hoop direction, and 2048 measurement data. It calculates in each point of measurement of 2048 (S33). constant of a proper in which the laser output monitor reinforcement of the laser light source (LD1) 11 has the light-receiving quantity of light reinforcement of the reflected light in a photo detector (PSD), and p0, and, as for p1, the quality of the material of an optical disk and optical system have n1 here it is .
- In order to compute the truck location of a degree, carry out the truck counter +1 (S34).
- Truck counter = when having not come to check whether it was set to 3, move in order to compute the truck location of a degree (S35). (S33)
- Plot the result of having computed all the sampled data, to a CRT display in a part for three trucks, and a hoop direction if needed (S36).
- Here, end the calculation stroke of a reflection factor (S37).
[0037] Next, judgment stroke of the result of #5 shown by drawing 9 using drawing 13 A step is further stated to a detail later on. First, the judgment of - result is started after ** of drawing 12 (S38).
- Judge whether the tilt angle calculation performed for the preceding clause exceeded the set point (S39).
- When a tilt angle exceeds the set point, as those with tilt defective, display the defective location and its defective data on a CRT display, and report them according to the host CPU (S40).
- The amount calculation of face deflections of the direction of a path performed for the preceding clause judges whether the set point was exceeded (S41).
- When the amount of face deflections exceeds the set point, as those with face deflection defective, display the defective location and its defective data on a CRT display, and report them according to the host CPU (S42).
- The face deflection acceleration calculation of the direction of a path performed for the preceding clause judges whether the set point was exceeded (S43).
- When face deflection acceleration exceeds the set point, as those with face deflection acceleration defective, display the defective location and its defective data on a CRT display, and report them according to the host CPU (S44).
- The reflection factor calculation performed for the preceding clause judges whether the set point was exceeded (S45).
- When a reflection factor exceeds the set point, as those with reflection factor defective, display the defective location and its defective data on a CRT display, and report them according to the host CPU (S46).

- Here, end a result judging stroke (S47).
[0038]
[Example] Next, one example of inspection of the optical disk using the optical disk test equipment of this invention is explained. Laser spot light was set to phi1mm which is easy to treat in this example. Mirrors 18, 19, and 20 were installed, in the example, the pneumatic cylinder was used for the mirror means for switching of mirrors 19 and 20, and it performed location evasion actuation so that the location of 25mm of most inner circumference, 40mm location of inside peripheries, and also 3 truck location of the 58mm of the outermost peripheries could be measured for the inspection location of the phi120mm optical disk (25) which is an inspected object centering on the shaft of a spindle (30). Moreover, the number of samplings of each truck is made into 2048 points, the encoder which generates a pulse is installed, and it enabled it to obtain an exact sampling position. Moreover, a pneumatic-clamp device is adopted as a spindle and it enabled it to fix a spindle to it less than in 0.2 as a disk clamp device.
[0039] It enabled it to change the rotational frequency of a spindle (30), it constituted from this example so that it could apply with 2400 rotation extent from 300 rotations, consequently the high-speed baton for less than 1.5 seconds has been realized. The concrete numeric value is shown below.
- Spindle fixed time : 0.15 second and motor acceleration time: 0.2 second and real inspection scan time amount: 0.8 seconds (mirror change-over control is included)
- motor deceleration time: 0.2 second and spindle fixed discharge: -- 0.15-second sum total: -- ** -- by this example, the synthetic inspection tact time was able to end inspection time amount within 1.5 seconds in consideration of the productivity drive in this way less than 1.5 seconds.
[0040]
[Effect of the Invention] If each inspection currently conducted according to the individual on another

inspection stage uses the test equipment of this invention conventionally, the item of optical properties, such as mechanical characteristics, such as amount Vertical Run-out of face deflections and face deflection acceleration Vertical acceleration, and optical tilt angle Optical tilt, a reflection factor Reflectivity, can be once inspected simply by inspection in a short time. Furthermore, the optical disk test equipment of this invention is simple for the structure of the optical system of equipment, and a device system, is excellent also in maintainability, and can constitute high degree of accuracy and test equipment [that it is high-speed and low price]. And the optical disk test equipment of this invention can carry out even the in-line total inspection of the production process of an optical disk, or the evaluation trial of an optical disk at high speed. Furthermore, the inspection range of the optical disk test equipment of this invention is also wide, it is excellent in repeatability with a high speed, a high resolution, and high degree of accuracy, and R, such as DVD, MO, and CD, R/W, RAM, etc. can inspect including a substrate.

[Translation done.]

* NOTICES *

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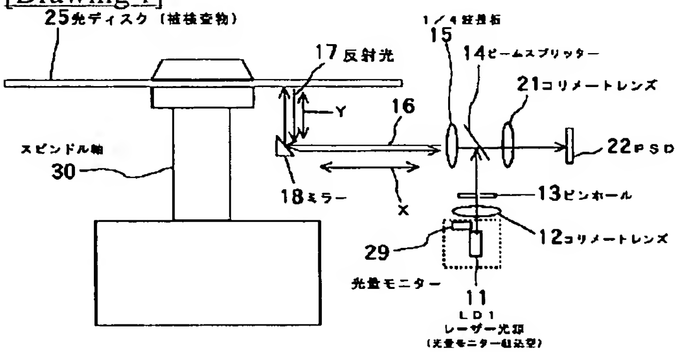
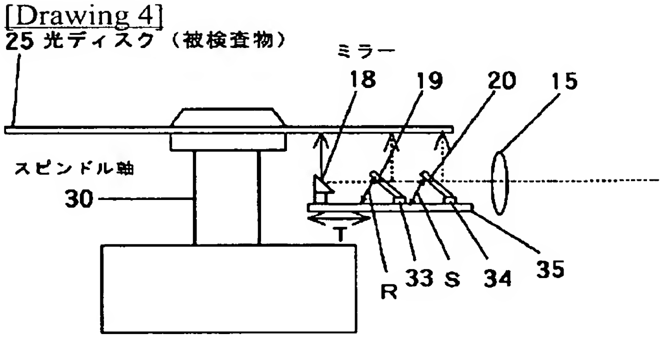
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

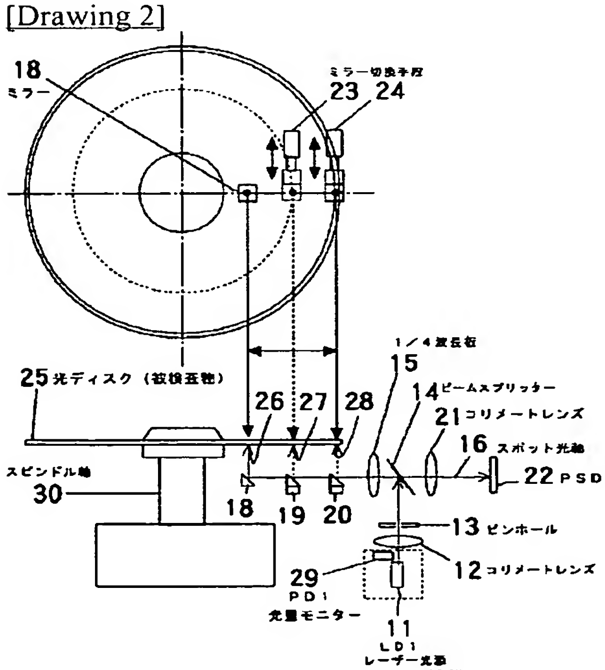
[Drawing 1]



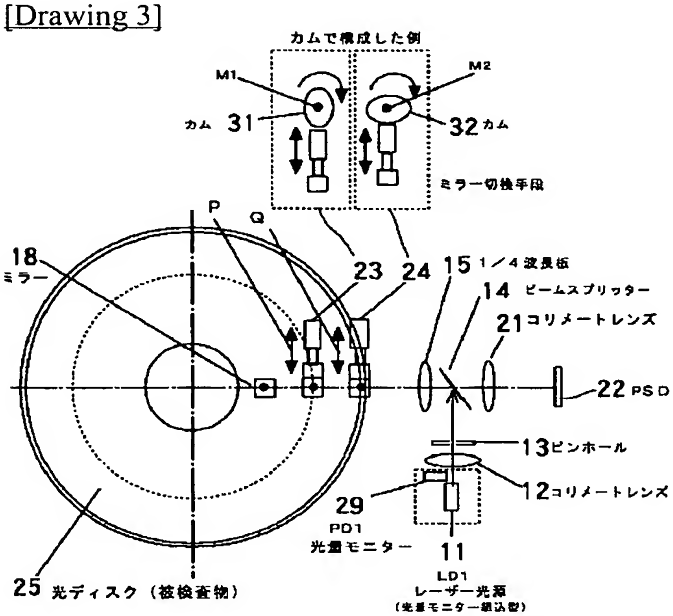
[Drawing 4]



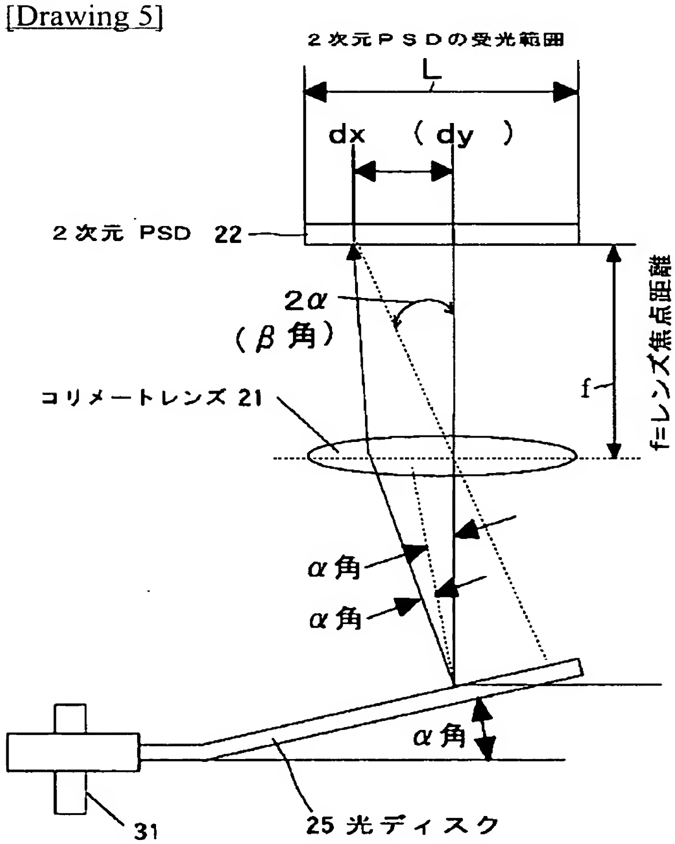
[Drawing 2]



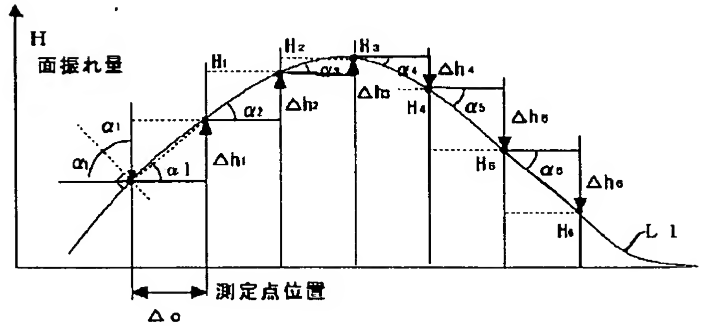
[Drawing 3]



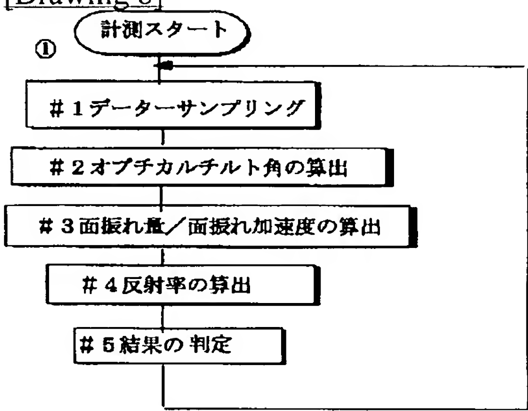
[Drawing 5]



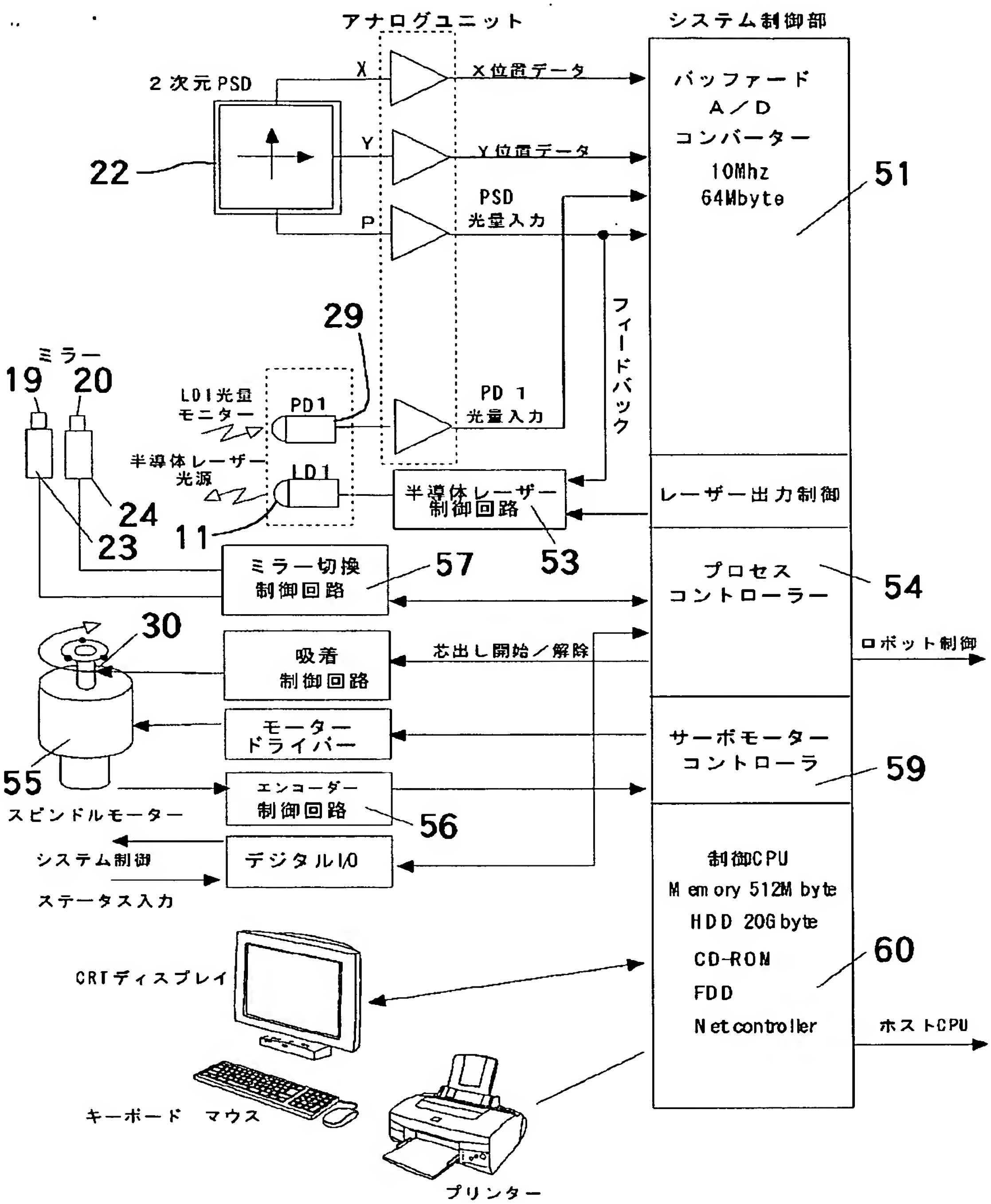
[Drawing 6]



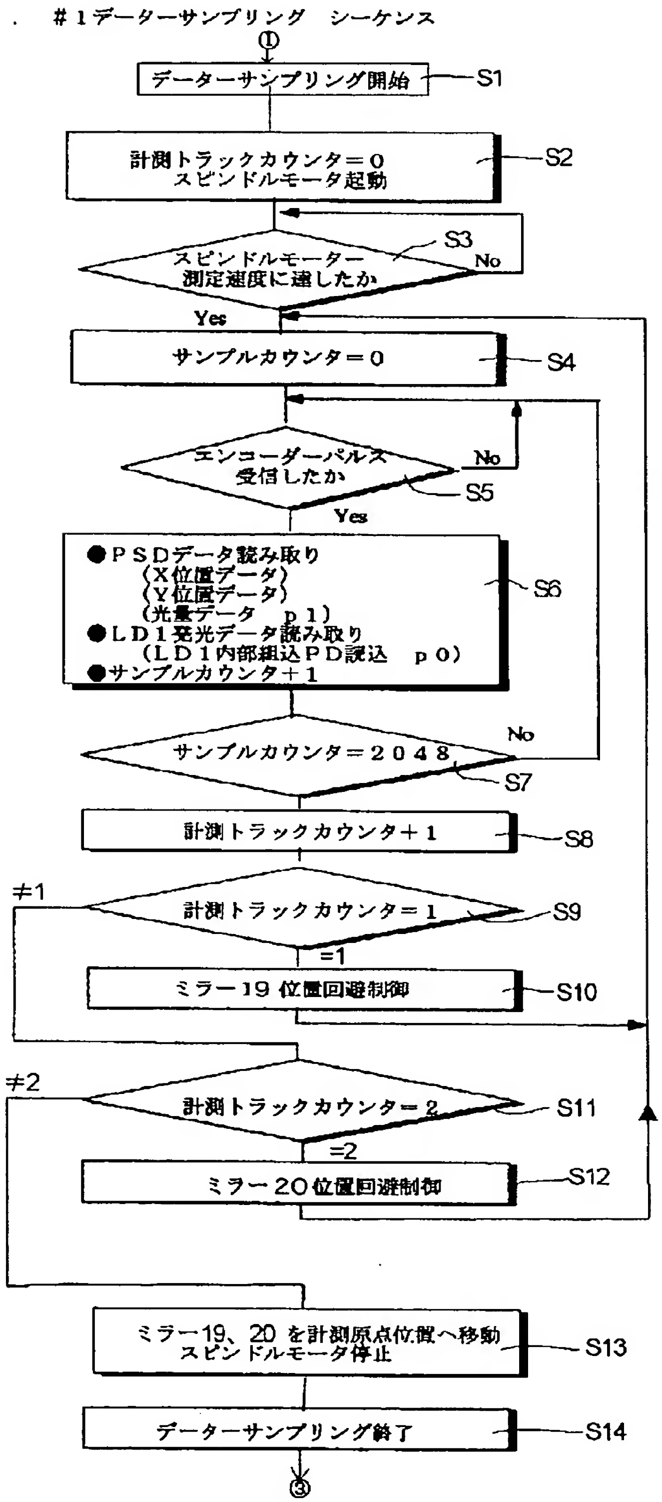
[Drawing 8]



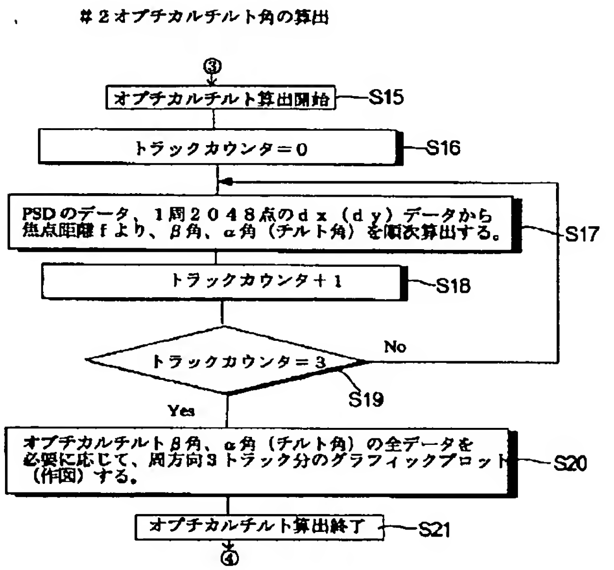
[Drawing 7]


アナログユニット
システム制御部
2次元PSD
X
Y
P
X位置データ
Y位置データ
PSD
光量入力
バッファード
A／D
コンバーター
10Mhz
64Mbyte
51
22
29
フィードバック
ミラー
19
20
LD1光量
モニター
PD1
PD 1
光量入力
半導体レーザー
光源
LD1
半導体レーザー
制御回路
レーザー出力制御
24
23
11
ミラー切換
制御回路
57
53
プロセス
コントローラー
54
30
吸着
制御回路
芯出し開始／解除
ロボット制御
モーター
ドライバー
サーボモーター
コントローラ
59
55
エンコーダー
制御回路
56
スピンドルモーター
システム制御
デジタルI/O
ステータス入力
制御CPU
Memory 512M byte
HDD 20G byte
CD-ROM
FDD
Net controller
60
ホストCPU
CRTディスプレイ
キーボード　マウス
プリンター

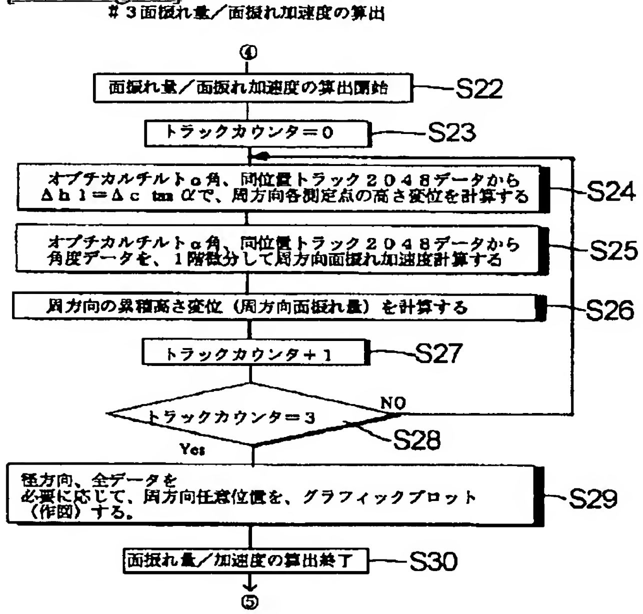
[Drawing 9]


#１データーサンプリング　シーケンス
①
データーサンプリング開始
S1
計測トラックカウンタ＝０
スピンドルモータ起動
S2
スピンドルモーター
測定速度に達したか
S3
No
Yes
サンプルカウンタ＝０
S4
エンコーダーパルス
受信したか
No
S5
Yes
●ＰＳＤデータ読み取り
（Ｘ位置データ）
（Ｙ位置データ）
（光量データ　ｐ１）
●ＬＤ１発光データ読み取り
（ＬＤ１内部組込ＰＤ読込　ｐ０）
●サンプルカウンタ＋１
S6
サンプルカウンタ＝２０４８
No
S7
計測トラックカウンタ＋１
S8
≠1
計測トラックカウンタ＝１
S9
=1
ミラー19 位置回避制御
S10
≠2
計測トラックカウンタ＝２
S11
=2
ミラー20位置回避制御
S12
ミラー19、20 を計測原点位置へ移動
スピンドルモータ停止
S13
データーサンプリング終了
S14
③

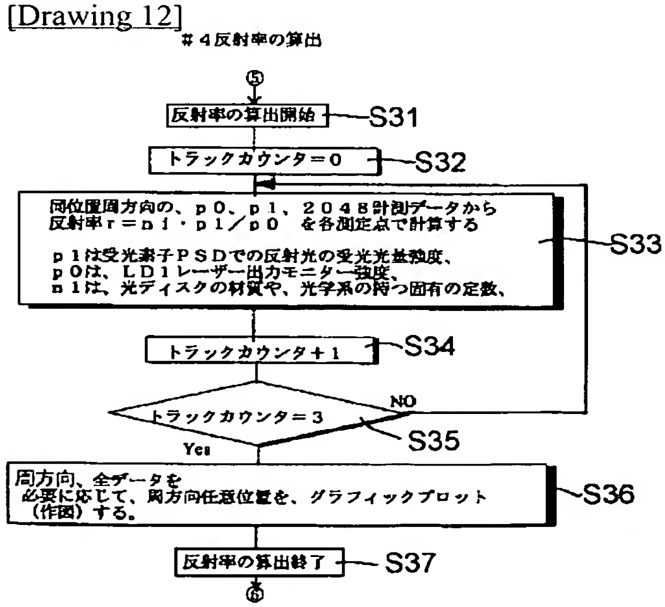
[Drawing 10]



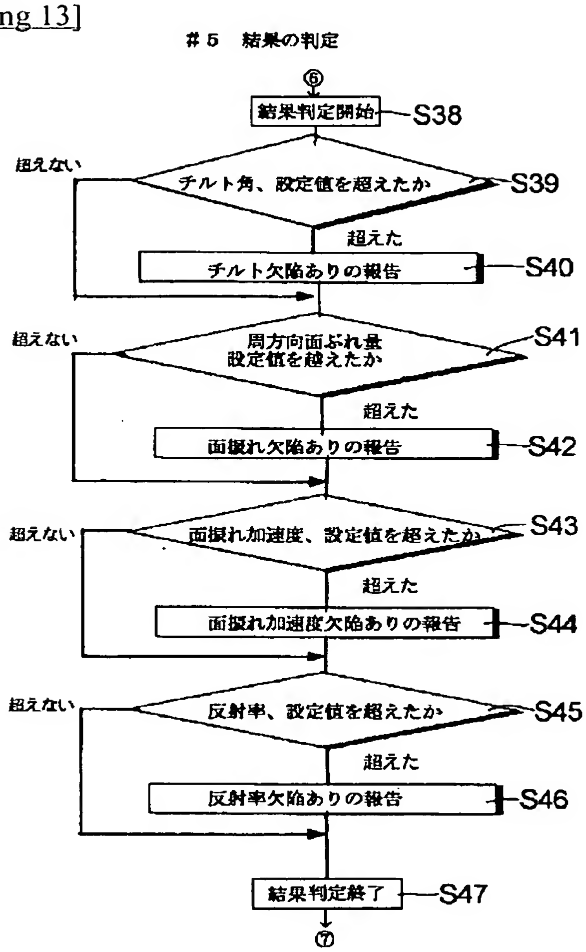
[Drawing 11]



[Drawing 12]



[Drawing 13]



[Translation done.]